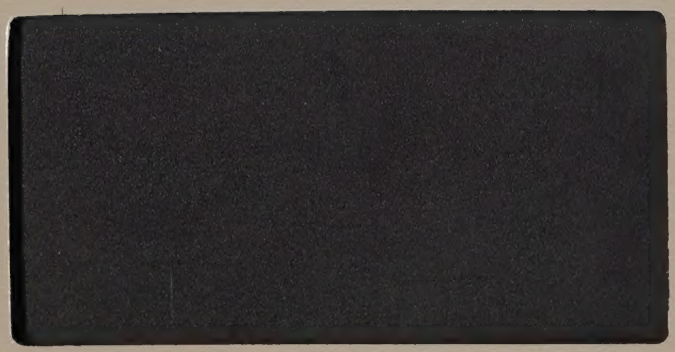
TEKTRONIX®

4952

JOYSTICK



BEFORE READING

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THIS MANUAL REPRINTED OCTOBER 1977

TEKTRONIX®

4952

JOYSTICK

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97005

Serial Number _____

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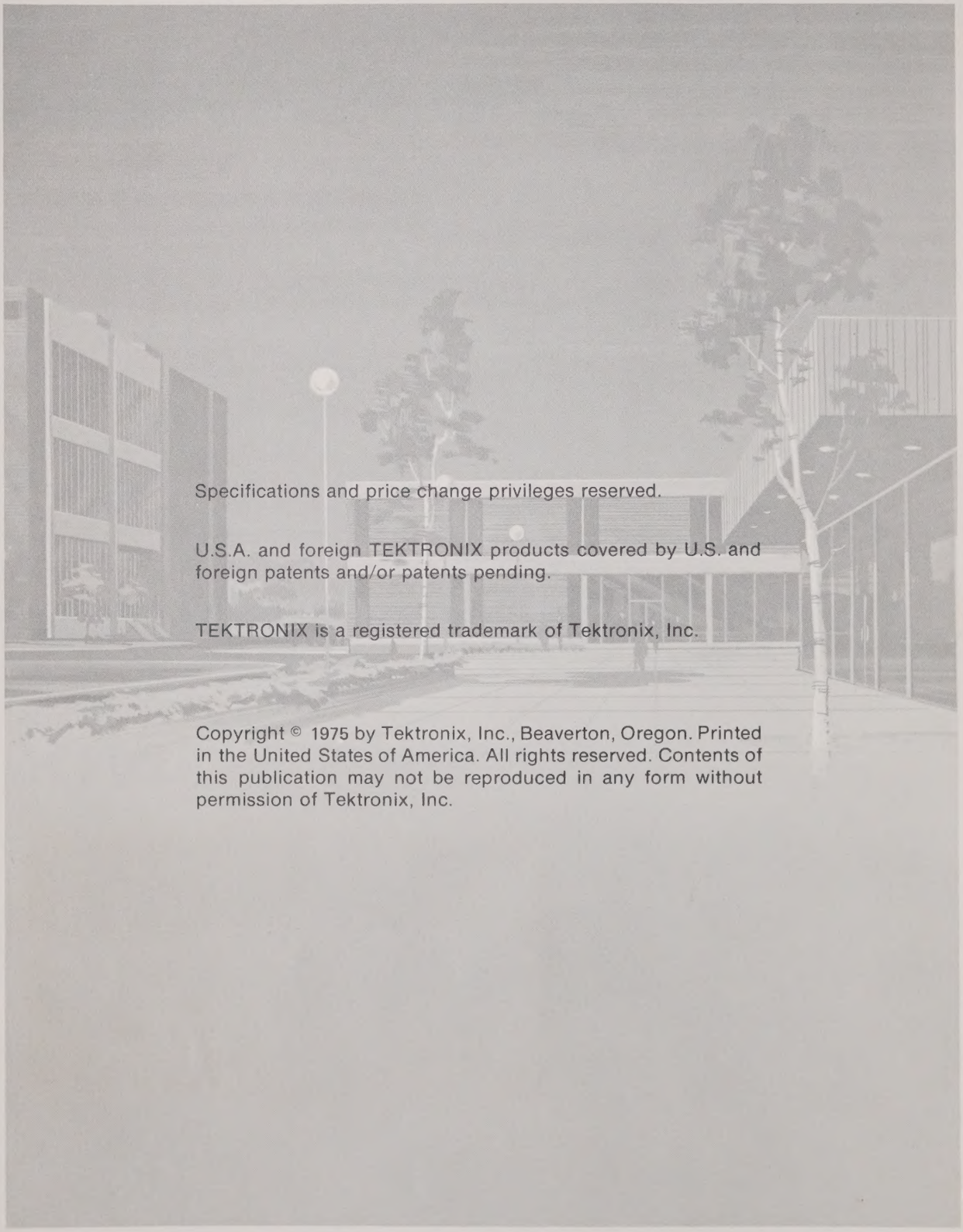
Revised JAN 1975



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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the users at their own expense will be required to take whatever measures may be required to correct the interference.

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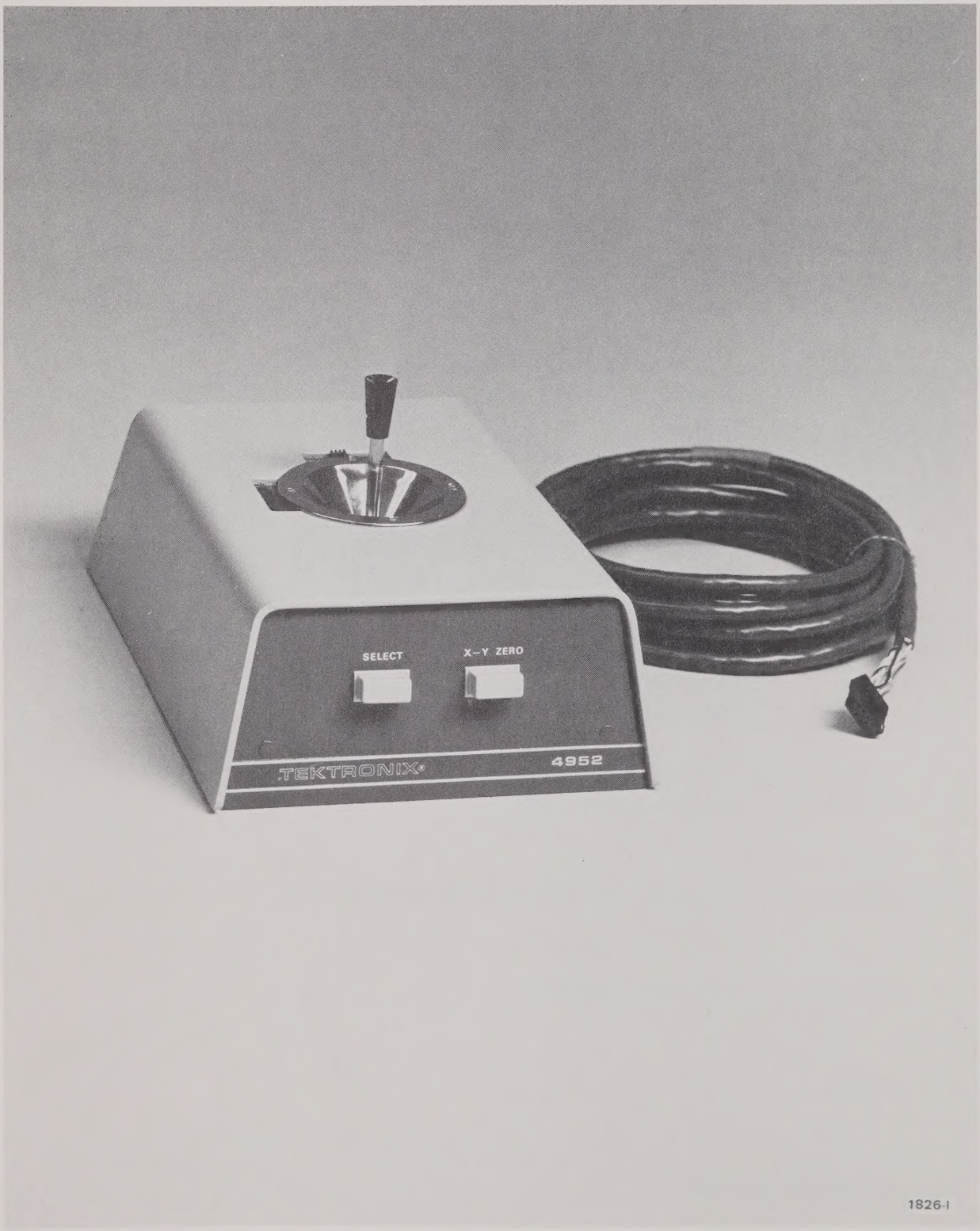


Fig. 1-1. 4952 Joystick.

INSTALLATION AND OPERATION

INTRODUCTION

This manual documents the 4952 Joystick. The Joystick is designed as an input device to provide control of the crosshair cursor on terminals (such as the Tektronix 4014, 4014-1, 4015, and 4015-1 Graphic Display Computer Terminals) during operator-controlled portions of the Graphic Input (GIN) Mode. Option 1 permits the Joystick to be used with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal. The Joystick attaches to the Terminal by a 10 foot cable and, depending on the SELECT switch position, allows either the Joystick or the thumbwheels (on the Terminal) to control the crosshair cursor position.

INSTALLATION

General

The only equipment necessary to install the Joystick is a Phillips screwdriver. The Joystick connector cable contains a ten-pin dual harmonica connector for connecting the Joystick cable to J20 on the TC-2 (Terminal Control) card internal to the pedestal of the Terminal. Access to TC-2 is obtained by opening the pedestal front cover. TC-2 is the card whose plug-pin configuration is as shown in Fig. 1-3. Pin-1 on the plug is labeled with a 1. Pin-1 on the jack pins (J20 on TC-2) is marked by a small arrow. The power should be off before connecting or disconnecting the Joystick cable to TC-2.

WARNING

Dangerous voltages exist at several locations within the pedestal. Disconnect the Terminal from the power source before feeding the cable through the rectangular cable port (back of pedestal) and connecting the cable to TC-2.

Connecting the Joystick to the Terminal

1. Turn off the power switch at the Terminal.

2. Open the pedestal front cover and locate TC-2, referring to Fig. 1-3.

3. Insert the cable from the Joystick through the rectangular cable port on back of the Terminal.

4. Connect the plug to J20 on TC-2; be sure to check the plug and jack index marks on the plug (end of connecting cable) and the jack pins (J20 on TC-2) to ensure proper alignment before connecting the cable to TC-2. The plug is marked by a 1 at pin-1. The jack pins have a small arrow at the base of pin-1. Pins 5 and 6 at the plug are empty.

5. If your 4014 or 4015 Computer Display Terminal use TC2 circuit card 670-3092-00, 01, 02, or 670-3559-00, 01, 02, it is necessary to change the orientation of the Joystick control. Procedure is to remove the four screws from the bottom of the Joystick housing and remove the bottom plate. Reverse each input connector as shown on the Figure 1-2. Reinstall the bottom plate.

In addition, circuit cards 670-3092-00, 01, or 670-3559-00, 01 will require a minor strap modification (refer to "Operation" step 7 Page 1-3.

6. Take the cable clamp, screw, washer, and nut from the installation hardware and secure the cable to the rectangular port flange. Use any convenient mounting hole.

7. Replace the pedestal front cover. The Joystick now is ready for use.

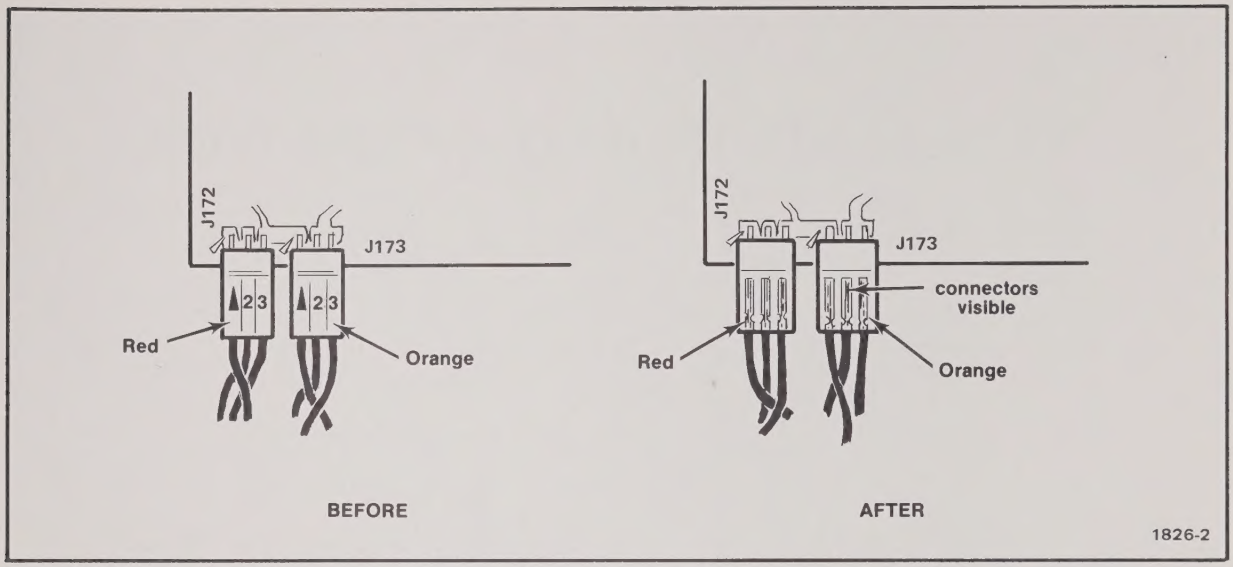


Fig. 1-2. Orientation change for use with some TC-2 circuit cards (see step 5 under the heading — Connecting the Joystick to the Terminal).

CONTROLS

Control Lever	Determines the speed and direction of crosshair cursor movement. The greater the control lever tilt, the faster the crosshair cursor moves. Direction of crosshair cursor movement depends on the direction of control lever tilt.
Drift Trim	Each axis has a drift trim tab, located near the cursor control lever, which provides adjustments for drift in its respective X or Y axis. They are adjusted for zero drift when the control lever is in its vertical, or centered, position.
SELECT	Locking push-button switch that, when pressed in, selects the Joystick inputs for crosshair cursor control. The out position disables the Joystick inputs and enables the keyboard thumbwheels to control the crosshair cursor.
X-Y ZERO	Push-button switch that, when pressed, causes the X and Y outputs from the Joystick to immediately become zero volts. If the SELECT button is in and the crosshair cursor is present on the display, the crosshair cursor moves immediately to the center of the screen.

OPERATION

Operation and Checkout

The following can be used as an instrument checkout procedure and can also be used to familiarize the operator with use of the Joystick.

1. With the Joystick properly installed in an operating Terminal, turn on the power; switch the Terminal to LOCAL operation; set the SELECT switch on the Joystick to the out position; enter an ESC Control-Shift Z sequence via the keyboard to obtain the GIN (Graphic Input) Mode. The crosshair should be displayed. The thumbwheels on the Terminal keyboard should control the crosshair cursor position.

2. Set the SELECT switch (the locking push-button switch on the Joystick) to the in position. This enables the Joystick to control the position of the crosshair cursor.

3. Press the X-Y ZERO push-button switch on the Joystick. Note that the crosshair cursor is immediately positioned near the center of the screen.

4. Check the operation of the cursor control lever. Any tilt of the control lever causes crosshair cursor movement. The rate of crosshair cursor movement depends on the degree of control lever tilt. The greater the degree of tilt, the faster the cursor moves; the lesser the degree of tilt, the slower the cursor moves. Direction of crosshair cursor movement depends upon the direction of control lever tilt. Tilt away from or tilt toward the operator, causes the

crosshair cursor to move up or down respectively. Tilt to the left or right results in corresponding left or right movement of the crosshair cursor. Permitting the control lever to return to its centered position causes the crosshair cursor to stop at its present location. There may be some drift, which can be eliminated with adjustment of the drift trim tabs as explained in step 5.

5. Adjust the drift trim tabs, located near the cursor control lever, for zero drift in their respective X or Y axis when the control lever is in its centered position. If the drift cannot be stopped, refer to the Adjustment Procedure in the Service section of this manual.

The following two steps are to be checked if the Joystick refuses to control the crosshair cursor.

6. If the Joystick refuses to operate, check the pin alignment at the Joystick cable connection on the TC-2 card within the Terminal. Refer to Fig. 1-3. Be sure to have the power off when connecting or disconnecting the cable.

7. On some early Terminals (Tektronix 4014, 4014-1, 4015, and 4015-1 Graphic Display Terminals) the TC-2 card (670-3092-00, 01, or 670-3559-00, 01) may require a minor modification to make it compatible with Joystick operation. Steps for modification follow. Refer to Fig. 1-3 as necessary. *If the Joystick controls the crosshair cursor of the Terminal, additional modification of the TC-2 card is not required.*

(a) Turn off the power at the Terminal.

(b) Short pin 6 of J20 to pin 8 of J20.

(c) Short pin 5 of J20 to pin 9 of J20.

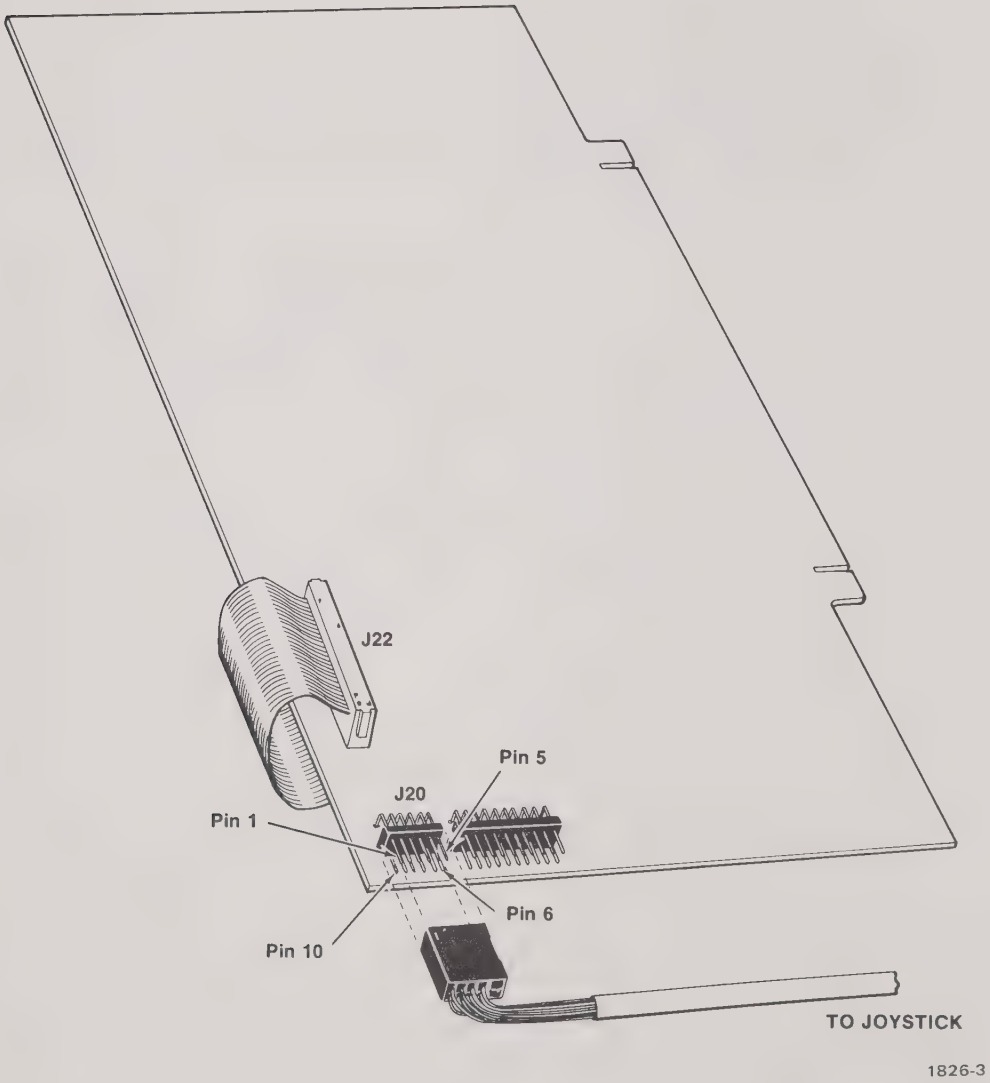


Fig. 1-3. Terminal Control Card (TC-2) sketch, showing J20 and pin locations.

SERVICE

INTRODUCTION

This section provides general maintenance information, instrument characteristics, and circuit descriptions to aid in servicing the 4952 Joystick. The Joystick is designed to be relatively maintenance free and having minimum service requirements. For information on replacement parts and assemblies, refer to the Electrical and Mechanical Parts Lists.

MAINTENANCE

Design of the Joystick allows it to receive a minimum of preventive maintenance, however, occasional cleaning of the instrument may be desired to keep the Joystick operating at its peak performance.

Cleaning of the instrument may be accomplished by using a cloth of soft-bristled brush to remove loose dirt. Stubborn dirt may be removed by using a cloth or cotton-tipped swab dampened with a mild soap or detergent solution.

Periodic checks of the integrated circuits are not recommended. The best check is actual operation.

To gain access to most of the components and assemblies within the housing, remove the four screws on the bottom of the Joystick, then remove the four stand-off mounts. This allows the bottom plate and the outer housing to be removed.

ADJUSTMENT PROCEDURE

The basic adjustments necessary for proper Joystick operation are already covered in the Operation and Checkout instructions. Performing the Operation and Checkout instructions should be all that is required in a Joystick adjustment procedure.

In the event that the drift trim tabs do not compensate for crosshair cursor drift, the following procedure may be used to reset the coarse drift adjustments. This procedure involves rotating resistors within the Joystick assembly and should be performed only by a qualified service technician. Refer to Fig. 2-1.

Equipment required to check the Power Supply and the Drift Adjustments include the following:

Voltmeter +15 V dc and −15 V dc with an accuracy of 1%.

Resistance meter with 1% accuracy at 1.25 kΩ.

For power supply checkout at the TC-2 (Terminal Control) Card within the Terminal, refer to Fig. 2-2 for jack and pin locations.

1. Turn off the power at the Terminal.

CAUTION

Connecting or disconnecting the Joystick cable while the power is on may cause damage to the Joystick.

2. To gain access to TC-2, loosen the top two thumbscrews on the Terminal's pedestal front cover.

3. Disconnect the Joystick cable from J20.

4. Turn on the power at the Terminal.

WARNING

Dangerous voltages exist at several locations within the pedestal.

5. Measure for approximately +15 V dc at pin 10 of J20 with respect to ground at pin 3 of J20.

6. Measure for approximately −15 V dc at pin 1 of J20 with respect to ground at pin 3 of J20.

7. The +15 V dc and −15 V dc power supplies should be centered about ground potential. Refer to the Terminal Service Manual if power supply corrections are necessary.

8. Turn off the power at the Terminal.

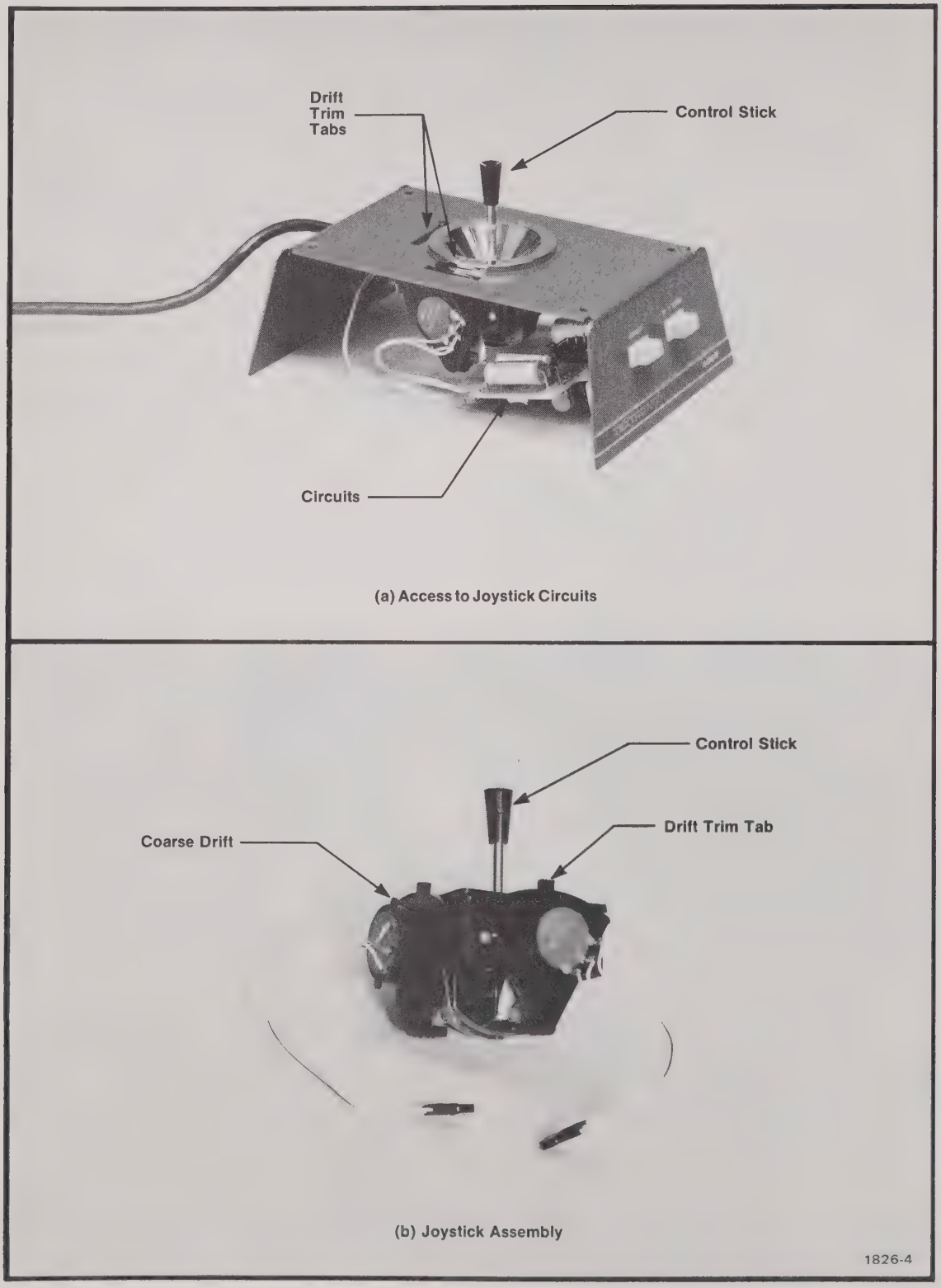


Fig. 2-1. Joystick adjustments and assemblies.

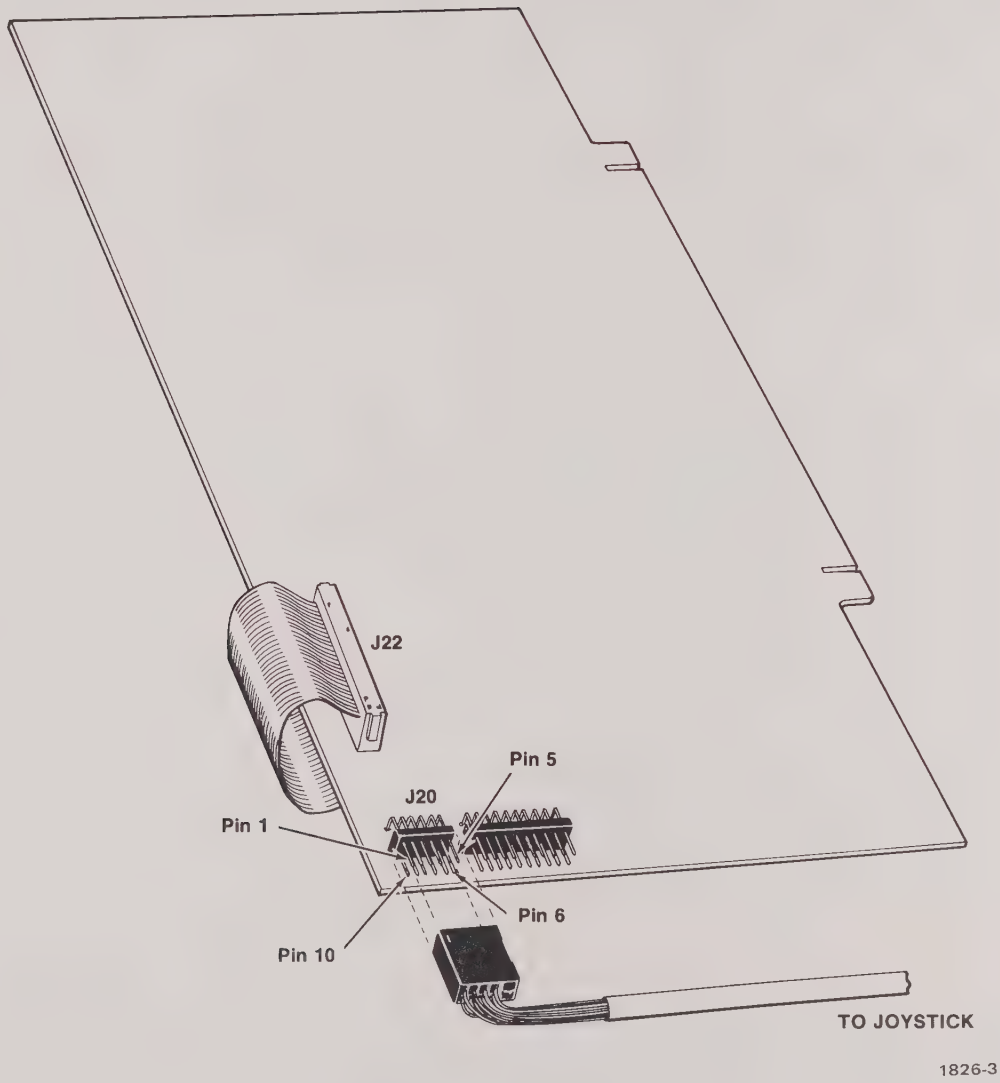


Fig. 2-2. Terminal Control Card (TC-2) sketch, showing J20 pin locations.

For checking the coarse drift adjustment, access to the internal circuitry of the Joystick is necessary. Do not perform these procedures if the Joystick functions properly and meets the operational requirements of the Operation and Checkout instructions.

1. Remove the four screws from the bottom of the Joystick housing; then remove the four stand-off mounts within the Joystick housing. Results are illustrated in Fig. 2-1a.

2. Remove the plugs from Y-POT (J173) and X-POT (J172). Note that pin 1 is accompanied with a small arrow on both the circuit card and the plug.

3. Measure the resistance between pins 1 and 3 on the control potentiometers. (Refer to Fig. 2-3.) The resistance should be approximately 5 kΩ.

4. To check the coarse drift adjustment, set the resistance meter to measure 1.25 kΩ. With a small piece of wire, short across pins 1 and 3. (Refer to Fig. 2-3.) Measure the resistance between pin 2 and the shorted pins. As the drift trim tab is moved back and forth from one extreme to the other, the measured resistance should reach a maximum near the center of the range of drift trim tab movement and should decrease as the drift trim tab is moved in either direction from center. If the maximum is reached near the center as just described, the coarse drift adjustments are properly set; assuming that crosshair cursor drift could not be stopped, trouble must exist elsewhere.

5. If coarse adjustments are needed, it will be necessary to remove the Joystick assembly (Fig. 2-1b) in order to properly position the resistors in the assembly. Then set the drift trim tabs at center and rotate the resistors to the position where maximum resistance is encountered. This completes the coarse drift adjustment.

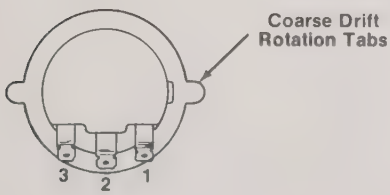


Fig. 2-3. Resistors on the Joystick assembly.

6. Restore original conditions. Replace the Joystick assembly in the housing. Remove all shorting wires and test equipment. Replace the X-POT and Y-POT plugs from the Joystick assembly on J172 and J173. Replace the top cover using the stand-off mounts. Replace the bottom cover on the stand-off mounts. Reconnect the Joystick cable to J20 on the TC-2 (Terminal Control) Card within the Terminal. Replace the Terminal pedestal cover.

CHARACTERISTICS

The instrument characteristics and specifications, other than operational characteristics described earlier, are tabulated below.

TABLE 2-1

ELECTRICAL CHARACTERISTICS

Parameter	Specification
Output Voltage Range X and Y, referenced to ground.	At least −12.0 V dc to +12.0 V dc (with load of 40 kΩ).
Resolution (X and Y)	Within one linear unit of addressable display information in the X or Y axis. There are 1024 units of addressable information per axis.
Time Drift	Adjustable to less than 1 addressable unit of drift in 30 seconds. There are 1024 addressable units per axis.
Power Source	+15 V dc and −15V dc from the Terminal.
Current Requirement	20 mA

TABLE 2-2

PHYSICAL CHARACTERISTICS

Parameter	Specification
Joystick	Spring return to center.
Trim Tabs	Mechanically rotate the X and Y potentiometers to control drift.
Net Weight	Approximately 2 pounds.
Dimensions	See Fig. 2-4 for maximum dimensions

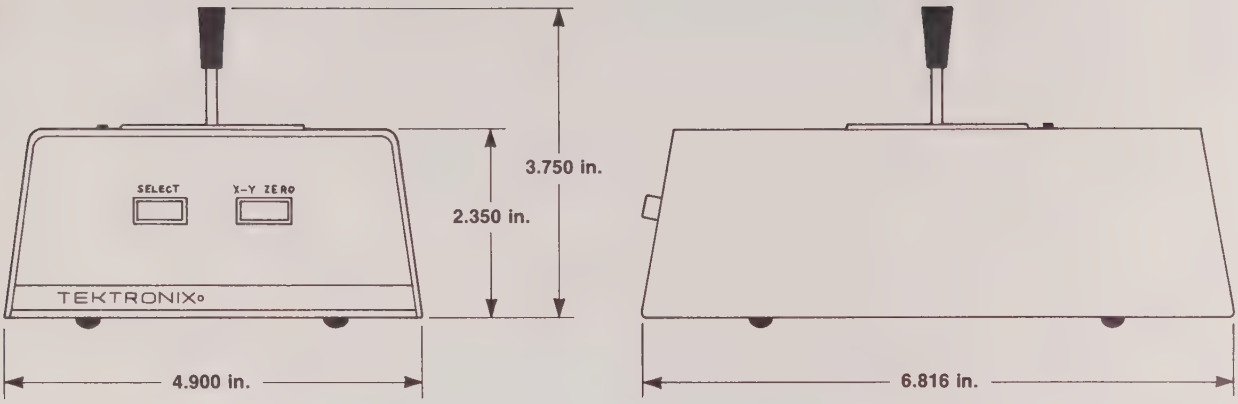


Fig. 2-4. Joystick Dimensions.

TABLE 2-3

ENVIRONMENTAL CHARACTERISTICS

Parameter	Specification
Temperature	
Operating Range	−10°C to +40°C
Storage Range	−40°C to +65°C
Humidity (maximum)	95% humidity at +30°C
Altitude	
Operating Range	To 15,000 feet
Storage Range	To 50,000 feet
Transportation	Tested to NSTC Procedure 1A with a 24 inch drop within its shipping carton.

CIRCUIT DESCRIPTION

Refer to the schematic diagram of the Joystick. The Joystick circuit consists of two integrating amplifiers and their driving amplifiers, controlled by the position of a control lever. Crosshair cursor position is relative to the output voltages from the integrating amplifiers at J171-1 and J171-5. Due to the similarities of X and Y channel operation, only the X channel is discussed.

An integrating amplifier has the ability to change its output at a rate determined by the amplitude of its input signal. If the input signal is removed, the output remains at its last value. If an input signal is continued to be applied, the amplifier output will eventually run into its electrical limit, regardless of the size of the input signal.

The voltage from R1001A at J172-2 is multiplied by ten through U112. Voltage output from U112 provides input to an integrating amplifier. The integrating amplifier consists of U133 with a large capacitor (C35) in the feedback circuit and resistors (R124 and R128) on the input. The sum of the currents through R124 and R128 determines the rate at which C35 charges or discharges.

When the control lever is vertical, or centered, the output voltage of U112 is less than ±0.6 volts, neither CR30 nor CR31 conduct current, thus providing a dead band and removing any noise from the input of U133. The voltage output from U133 remains fixed at its present value. The crosshair cursor is held at the intersect point to which it was last driven.

If the control lever is tilted slightly, causing the output voltage of U112 to be greater than 0.6 volts and less than 7 volts, all the charging current for C35 comes through R124. This slow charging rate allows the operator to smoothly and accurately position the crosshair cursor.

The capacitor and diodes, not already discussed, provide power supply filtering and surge current protection for the amplifiers. Surge currents may occur by connecting or disconnecting the Joystick to the Terminal while the power is on, by turning the power on and off, and by pressing the X-Y ZERO switch (S45).

For large offsets of the control arm, the voltage from U112 exceeds 7 volts, causing zener diodes VR125 and VR127 to become active, thus passing current through R128. The charging time of C35 is thus decreased to permit rapid cursor movement.

The control switches SELECT (S25) and X-Y ZERO (S45) provide the following functions. The SELECT switch causes J170-1 to become grounded, thus activating circuitry within the Terminal to select the output of the Joystick to control the position of the crosshair cursor. The X-Y ZERO switch, when pressed, causes the integrating capacitors to immediately discharge and move the crosshair cursor to the center of the screen.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
0000F	KRAFT SYSTEM, INC.	450 WEST CALIFORNIA AVE.	VISTA, CA 92802
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153

OPTION 1

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
86684	RCA CORP., ELECTRONIC COMPONENTS	415 S. 5TH ST.	HARRISON, NJ 07029

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
	670-3680-00	B010100	B019999	CKT BOARD ASSY:JOYSTICK	80009	670-3680-00
	670-3680-01	B020000		CKT BOARD ASSY:JOYSTICK	80009	670-3680-01
C4	290-0215-00			CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DC4
C5	283-0010-00	XB020000		CAP.,FXD,CER DI:0.05UF,+80-20%,50V	56289	273C20
C8	290-0215-00			CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DC4
C9	283-0010-00	XB020000		CAP.,FXD,CER DI:0.05UF,+80-20%,50V	56289	273C20
C10	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C12	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C35	285-0894-00			CAP.,FXD,PLSTC:5UF,5%,50V	84411	TEK34-505-5-R5
C50	285-0894-00			CAP.,FXD,PLSTC:5UF,5%,50V	84411	TEK34-505-5-R5
C107	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
C139	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
CR5	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR7	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR30	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR31	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR33	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR34	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR52	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR53	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR62	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
CR64	152-0323-00			SEMICOND DEVICE:SILICON,35V,100MA	03508	SE365
R14	315-0101-00	XB020000		RES. FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R37	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R47	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R60	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R105	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R106	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R124	315-0335-00			RES.,FXD,COMP:3.3M OHM,5%,0.25W	01121	CB3355
R128	315-0204-00			RES.,FXD,COMP:200K OHM,5%,0.25W	01121	CB2045
R129	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R137	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R138	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R145	315-0101-00	XB020000		RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1015
R159	315-0335-00			RES.,FXD,COMP:3.3M OHM,5%,0.25W	01121	CB3355
R165	315-0204-00			RES.,FXD,COMP:200K OHM,5%,0.25W	01121	CB2045
R1001	119-0670-00			RESISTOR ASSY:GIMBAL MT,2 X 5K OHM,1W	0000F	900-032
S25	260-1211-00			SWITCH,PUSH:DPDT,PUSH-PUSH	71590	2KAB010000-357
S44	260-1421-00			SWITCH,PUSH:	80009	260-1421-00
U112	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	07263	U6T7741393
U133	156-0335-00	B010100	B019999	MICROCIRCUIT,DI:OP AMPL,FET INPUT	12040	LH740AC
U133	158-0770-00	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0770-00
U147	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	07263	U6T7741393
U150	156-0335-00	B010100	B019999	MICROCIRCUIT,DI:OP AMPL,FET INPUT	12040	LH740AC
U150	156-0770-00	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0770-00
VR125	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR127	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR161	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR163	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A

SECTION 4
DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

Symbols used on the diagrams comply with USA Standard Y32.2-1970.

Logic symbology complies with ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:

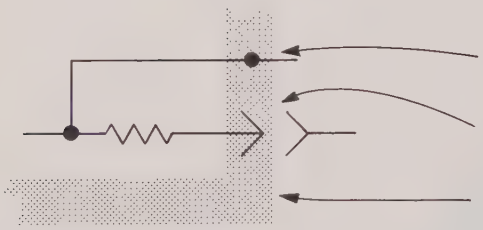
Screwdriver adjustment.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Square-pin contacts for strap option contacts and off-board plug connectors.

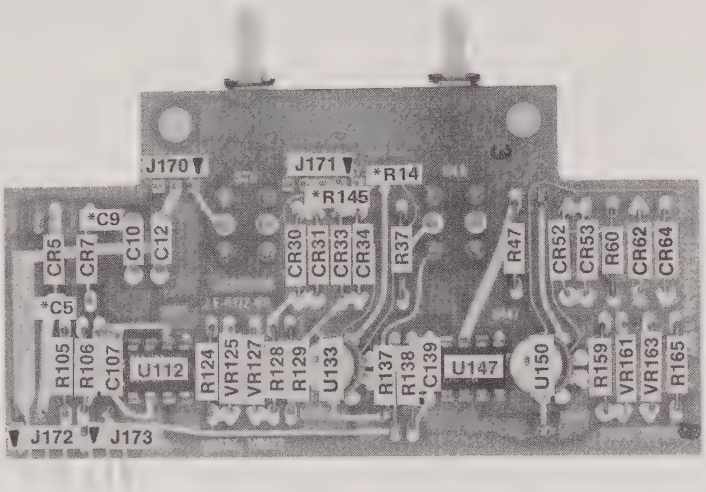

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

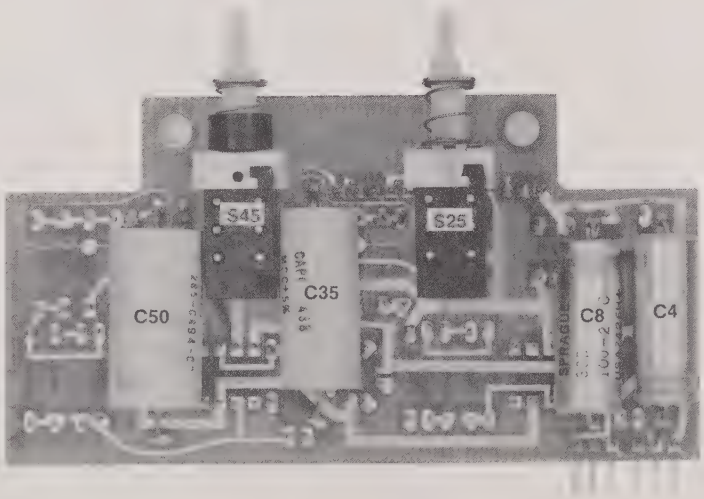
Tint encloses components located on circuit board.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

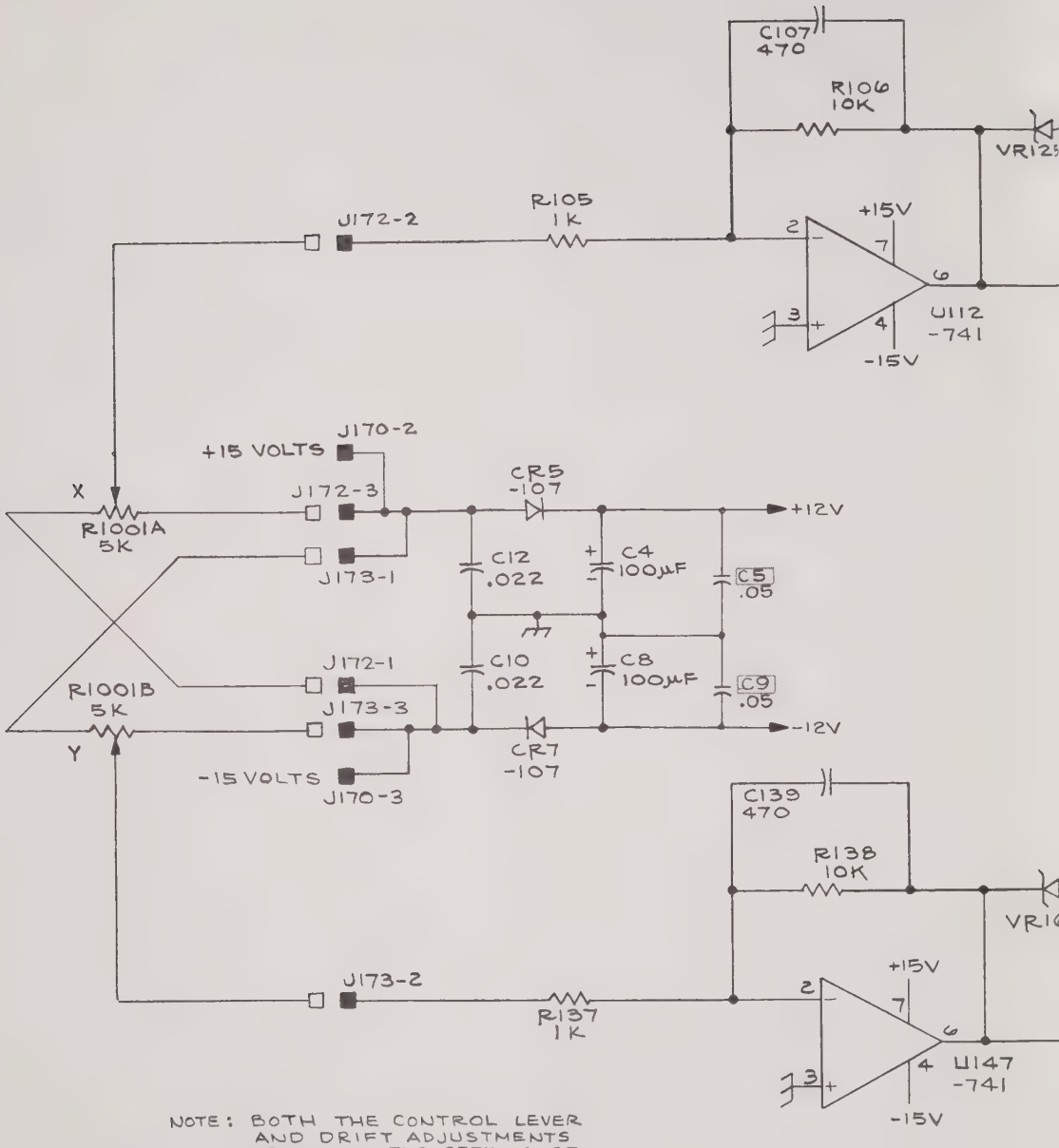


(Front)



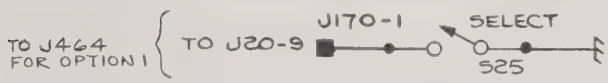
(Back)

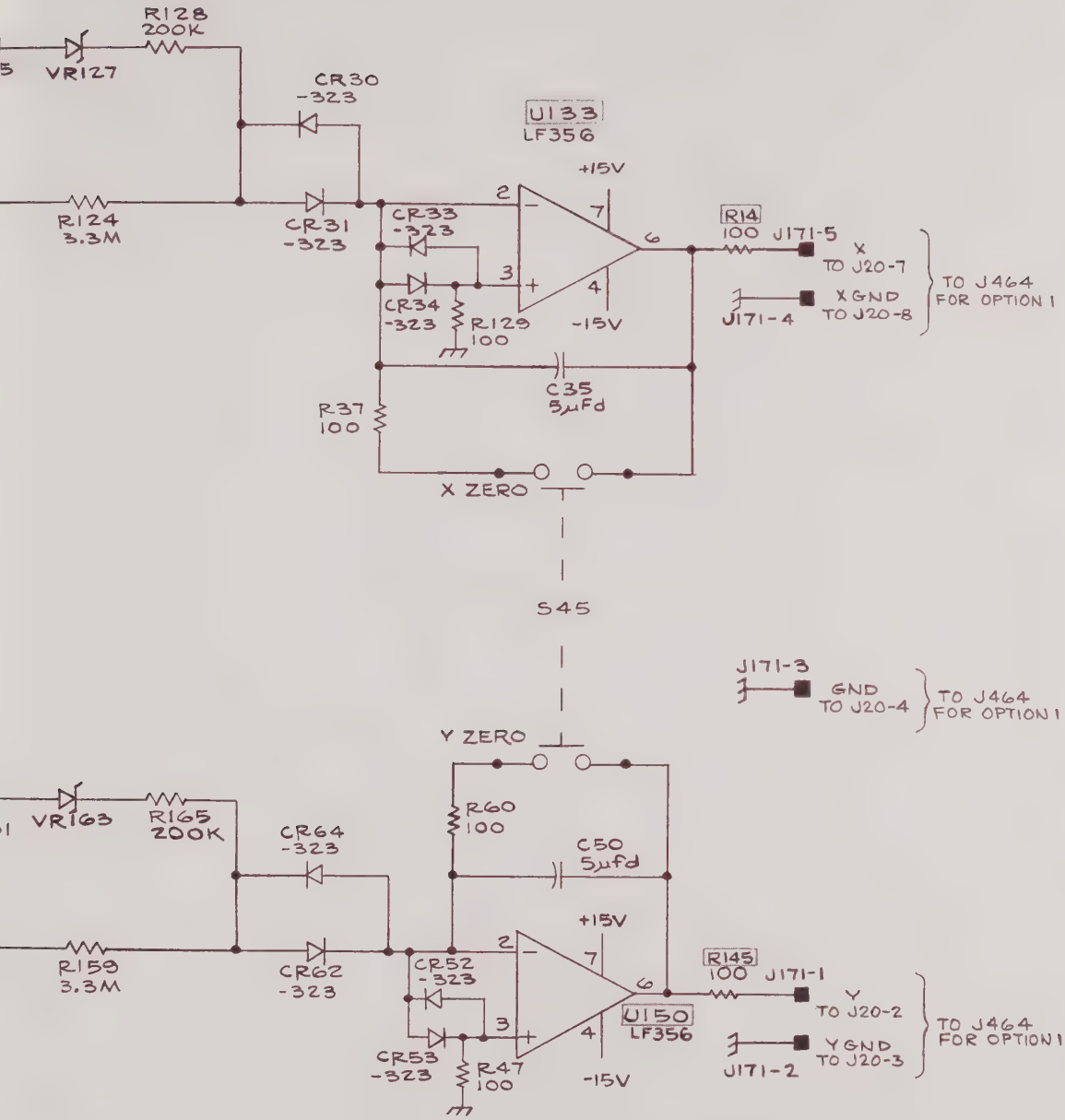
*See Parts List for serial number ranges.



NOTE: BOTH THE CONTROL LEVER AND DRIFT ADJUSTMENTS DETERMINE THE SETTING OF R1001A AND R1001B.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.





JOYSTICK

670-3680-00,01

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
\- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
\- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
\- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

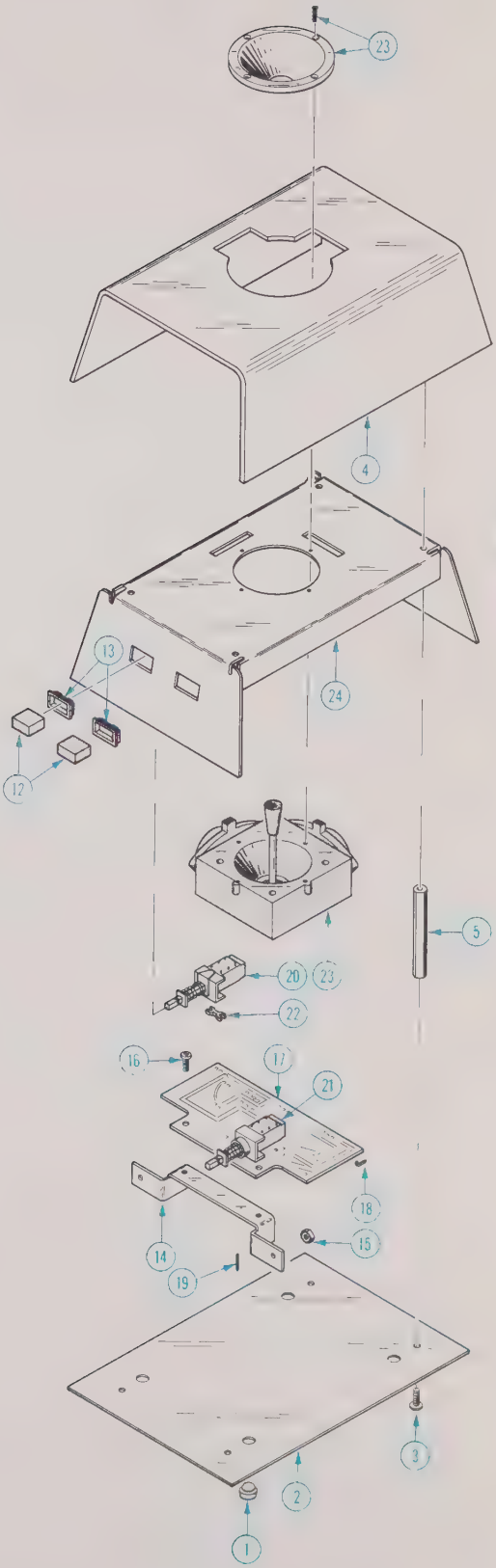
CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
0000F	KRAFT SYSTEM, INC.	450 WEST CALIFORNIA AVE.	VISTA, CA 92802
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
03508	GENERAL ELECTRIC CO., SEMI-CONDUCTOR PRODUCTS DEPT.	ELECTRONICS PARK	SYRACUSE, NY 13201
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
12040	NATIONAL SEMICONDUCTOR CORP.	COMMERCE DRIVE	DANBURY, CT 06810
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NB 69153

OPTION 1

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83501	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	CENTRAL ST.	BROOKFIELD, MA 01506

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	348-0013-00			4	BUMPER,RUBBER:	70485	1561
-2	390-0454-00			1	CAB SECT,CONT:BOTTOM	80009	390-0454-00
					(ATTACHING PARTS)		
-3	211-0581-00			4	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-4	390-0453-00			1	CAB SECT,CONT:TOP AND SIDES	80009	390-0453-00
					(ATTACHING PARTS)		
-5	129-0531-00			4	SPACER,POST:0.25 HEX,2 INCHES LONG	80009	129-0531-00
					- - - * - - -		
	175-1566-00	B010100	B010339	1	CABLE ASSEMBLY:MODEM	80009	175-1566-00
	175-1566-01	B010340		1	CABLE ASSEMBLY:MODEM	80009	175-1566-01
					(ATTACHING PARTS)		
-6	358-0161-00			1	BSHG,STRAIN RLF:FOR 0.25 INCH CABLE	28520	SR5P4
					- - - * - - -		
	----- -----			-	. MODEM CABLE INCLUDES:		
-7	352-0161-00			1	. HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0161-00
-8	352-0163-00			1	. HOLDER,TERM.CON:5 WIRE BLACK	80009	352-0163-00
-9	352-0330-03			1	. HOLDER,TERM.CON:DOUBLE ROW,5	80009	352-0330-03
-10	131-0707-00	B010100	B010339	16	. CONTACT,ELEC:0.48" L,22-26 SWG WIRE	22526	47439
	131-0707-00	B010340		14	. CONTACT,ELEC:0.48" L,22-26 AWG WIRE	22526	47439
	131-1159-00	XB010340		2	. CONTACT,ELEC:250 FASTEN	00779	60041-2
-11	175-1553-00	B010100	B010339	FT	. CABLE,SP,ELEC:11.5 FT LONG	80009	175-1553-00
	175-1157-00	B010340		FT	. CABLE,SP,ELEC:11.5 FT LONG	80009	175-1157-00
	343-0549-00	XB010340		1	STRAP,TIE DOWN:0.091 W X 3.62 INCH LONG	59730	TY23M
-12	366-1161-00			2	PUSHBUTTON:GRAY	80009	366-1161-00
-13	426-0568-00			2	FRAME,PUSH-BTN:GRAY	80009	426-0568-00
-14	407-1594-00			1	BRACKET,CKT BD:MAIN	80009	407-1594-00
					(ATTACHING PARTS)		
-15	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-16	211-0590-00			2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-17	----- -----			1	CKT BOARD ASSY:JOYSTICK(SEE EPL FOR PN)		
-18	131-0589-00			6	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-19	131-0608-00			8	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-20	260-1211-00			1	. SWITCH,PUSH:DPDT,PUSH-PUSH	71590	2KAB010000-357
-21	260-1421-00			1	. SWITCH,PUSH:	80009	260-1421-00
-22	361-0542-00			4	. SPACER,SWITCH:PLASTIC	71590	J-64281
-23	119-0670-00			1	RESISTOR,ASSY:GIMBAL MT,2 X 5K OHM,1W	0000F	900-032
-24	390-0452-00			1	CAB,SEC,CONT:FRONT AND REAR	80009	390-0452-00
-25	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON	08261	TEK-175-0826-00
	131-0707-00			6	CONTACT,ELEC:0.48" L,22-26 AWG WIRE	22526	47439
	352-0161-00			2	HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0161-00
	343-0002-00			1	CLAMP,LOOP:0.188 INCH DIA	95987	3-16-6B
					(ATTACHING PARTS)		
	211-0511-00			1	SCREW,MACHINE:6-32 X 0.500,PNH,STL	83385	OBD
	210-0863-00			1	WSHR,LOOP CLAMP:	95987	C191
	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,INCH,STL	83385	OBD
					- - - * - - -		
					ACCESSORIES		
	070-1826-01			1	MANUAL,TECH:INSTRUCTION(NOT SHOWN)	80009	070-1826-01



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11
10
9
8
7
25

OPTIONS

The 4952 Joystick has the following options available at the time of this printing. Please refer to the Tektronix Catalog for an up-to-date listing of options.

Option 1	This option permits the Joystick to operate with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal. The Option 1 for the 4952 Joystick can be purchased separately. The part number is given in the Option 1 Replaceable Parts List.

4952 JOYSTICK OPTION 1

CONTENTS

	Option 1 Page
INTRODUCTION	1
INSTALLATION	1
CHARACTERISTICS	3
CIRCUIT DESCRIPTION	3
ELECTRICAL PARTS LIST	5
DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS	

4952 JOYSTICK OPTION 1

INTRODUCTION

Option 1 permits the Joystick to operate with the 4010, 4010-1, 4012, or the 4013 Computer Display Terminal.

Option 1 consists of a Joystick Adapter circuit card that inserts the minibus within the terminal. Two supplied ribbon cables are used to interconnect to the signals from the TC-2 terminal circuit card. The Joystick interconnects with the Joystick Adapter circuit card.

This insert contains a circuit diagram, circuit board component locations, and other information that are unique to Option 1 and not included elsewhere in the manual. Whenever information contained in the manual might be useful in using the insert, the reader is referred to the proper section of the manual.

INSTALLATION

General

Installation of the Joystick Adapter circuit card requires access into the terminal by opening the pedestal front cover. The power should be off before connecting or disconnecting the Joystick cable.

WARNING

Dangerous voltages exist at several locations within the pedestal. Disconnect the terminal from the power source during installation.

NOTE

Early serial numbered 4010's with TC-2 marked 670-1729-04 and below, change R53 and R75 to 18.7 kΩ 1/8 W 1% (Tektronix Part No. 321-0315-00). This will enable the crosshair display to be positioned to the edge of the screen.

Procedure

Use the following procedure to install the Joystick Adapter into a 4010, 4010-1, 4012, or 4013 Computer Display Terminal.

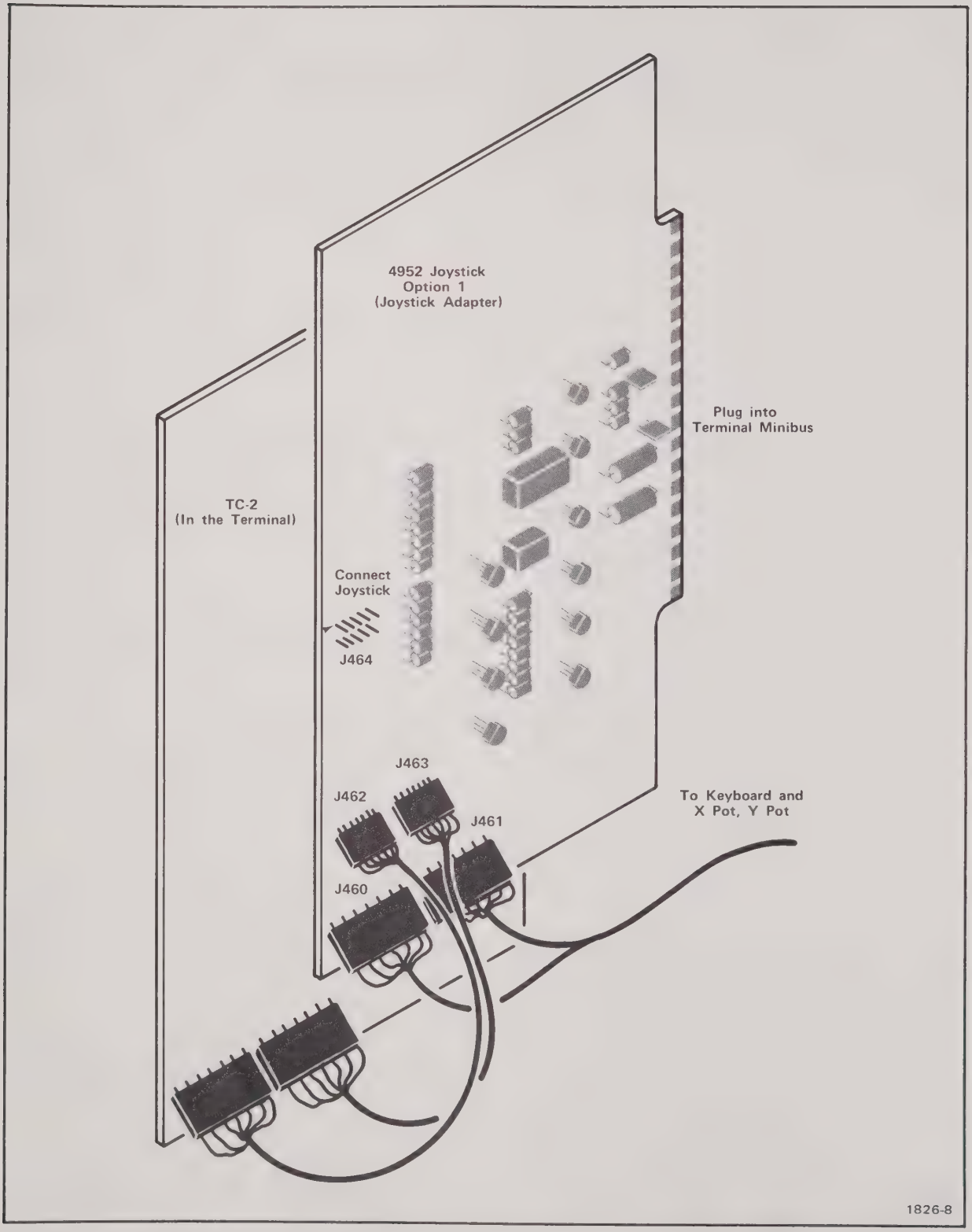
1. Turn the terminal Power OFF.

2. Open the terminal pedestal front cover and locate TC-2, refer to Option 1, Fig. 1.

3. Insert the Joystick Adapter circuit board into an available position of the terminal's bus. (If no positions are available, a Minibus Extender, Tektronix Part No. 018-0069-01 must be installed in the terminal to allow the adapter circuit board to be inserted.)

4. Disconnect the cables leading to the TC-2 and connect them with the same arrangement to J460 and J461 on the Joystick Adapter circuit board (see Option 1, Fig. 1).

5. Use the two supplied flat ribbon cables to connect from J462 and J463 on the Joystick Adapter circuit board to the similarly arranged pins on the TC-2.



Option 1 Fig. 1. Installation Information.

6. Insert the cable from the Joystick through the rectangular port on the back of the terminal. Connect the cable plug to J464 on the Joystick Adapter circuit board; be sure to check the plug and jack index marks on the plug (end of the connecting cable) and the jack pins on J464 to ensure proper alignment before connecting the cable. The plug is marked with a 1 at pin 1. The jack pins have a small arrow at the base of pin 1.

7. Take the cable clamp, screw, washer, and nut from the installation hardware and secure the cable to the rectangular port flange. Use any convenient mounting hole.

8. Replace the pedestal front cover. The Joystick now is ready for use.

OPTION 1 TABLE 1

Electrical Characteristics

Parameter	Maintenance & Operation
X Axis Output Voltage Range	−14.5 V to +14.5 V into 30 kΩ with ±15.0 V on edge connector.
Y Axis Output Voltage Range	−14.5 V to +14.5 V into 30 kΩ.
Worst-case Current Requirements	
+15 V	35 mA max.
−15 V	45 mA max.
+ 5 V	5 mA max.

CHARACTERISTICS

General

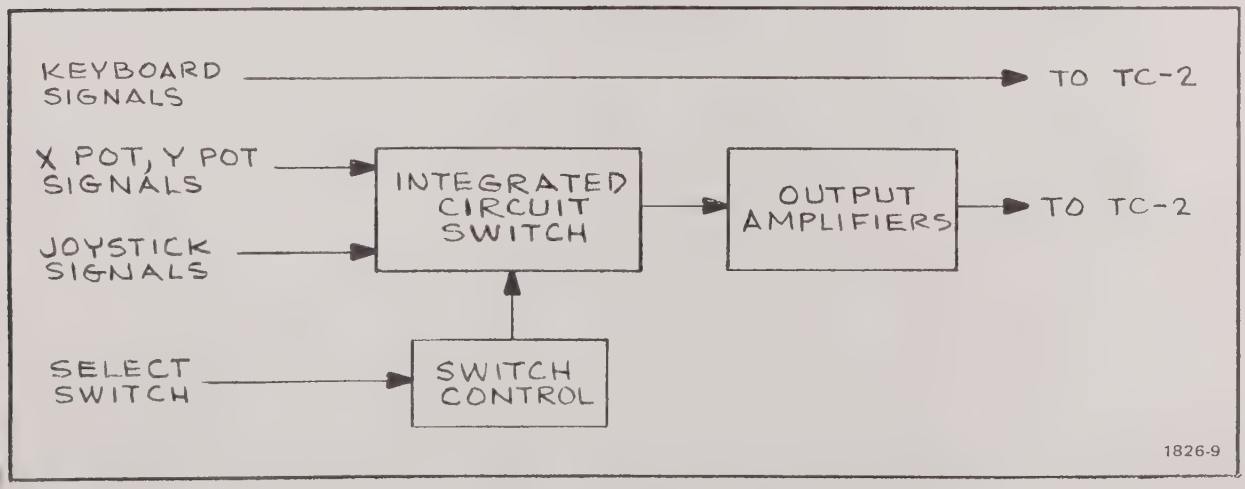
When the Joystick Adapter circuit board is installed in a 4010, 4010-1, 4012, or a 4013 Computer Display Terminal, the general characteristics and operation of the Joystick is the same as described in the manual.

Electrical Characteristics

The following Electrical Characteristics Table lists the changes as a result of Option 1.

CIRCUIT DESCRIPTION

Refer to Option 1, Fig. 2 and the Joystick Adapter circuit diagram. The circuit consists of an integrated circuit switch to select the X POT and Y POT signals from the Terminal or the Joystick signals for use of the Terminal. As shown in the block diagram, the Joystick Select switch, through the Switch Control circuit, controls the integrated circuit switch.



Option 1 Fig. 2. Joystick Adapter block diagram.

Input Dividers

The input signals, X POT, Y POT from the Terminal thumbwheels that feed through J460, and the X, Y signals from the Joystick that feed through J464 are divided by the resistor networks in the Input Divider circuit. The reduced signals feed the input of U149.

Switch

Only one pair of switches are closed at a time in the quad switch U149. The switch connects either the terminal's thumbwheels or the Joystick signals to the output amplifiers. The Switch Control circuit sets a high at pin 12 and 13 to connect the terminal's thumbwheel signals, or a high at pin 5 and 6 to connect the Joystick signals. Note that a −10 volt supply is required for U149, and is set by VR251.

Output Amplifiers

Each output amplifier (the X and the Y amplifiers are identical) drives the X OUT and Y OUT signals to the TC-2 circuit in the terminal via J462. The X amplifier consists of operational amplifier U142B driving the bases of Q135 and Q137. Q135 and Q137 drive Q129 and Q142 output circuit to output the X OUT signal. The output circuit allows a large voltage swing and the amplifier has an overall gain of about 9.

Switch Control

When locking pushbutton switch Select is pressed in, the SELECT line from the Joystick is low. This low turns Q255 on to apply a high to U149 pins 5 and 6 that connects the Joystick signals to the output amplifiers. Conduction of Q255 forward biases Q249 to apply a low on U149 pins 12 and 13 to effectively cutoff the terminal thumbwheel signals to the output amplifiers.

When the Select switch is in the out position (or the Joystick disconnected from J464) both Q255 and Q249 are off. This allows U149 pin 12 and 13 to be pulled high, which connects the terminal thumbwheel signals to the output amplifier.

REPLACEABLE ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
.	670-4041-00			CKT BOARD ASSY:JOYSTICK ADAPTER	80009	670-4041-00
C242	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C245	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C249	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C254	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
Q129	151-0190-02			TRANSISTOR:SILICON,NPN	04713	2N3904
Q135	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q137	151-0190-02			TRANSISTOR:SILICON,NPN	04713	2N3904
Q142	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q229	151-0190-02			TRANSISTOR:SILICON,NPN	04713	2N3904
Q235	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q237	151-0190-02			TRANSISTOR:SILICON,NPN	04713	2N3904
Q242	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q249	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q255	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
R39	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R41	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R42	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R43	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R44	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R45	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R47	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R49	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R51	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R52	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R54	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R55	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R57	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R59	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R129	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R131	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R135	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R137	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R138	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R139	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R140	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R141	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R153	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R155	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R157	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R249	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R252	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R255	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
U142	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	S5558U
U149	156-0289-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	86684	CD4016AE
VR251	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	1N961B

REPLACEABLE MECHANICAL PARTS

(OPTION 1) EXPLODED

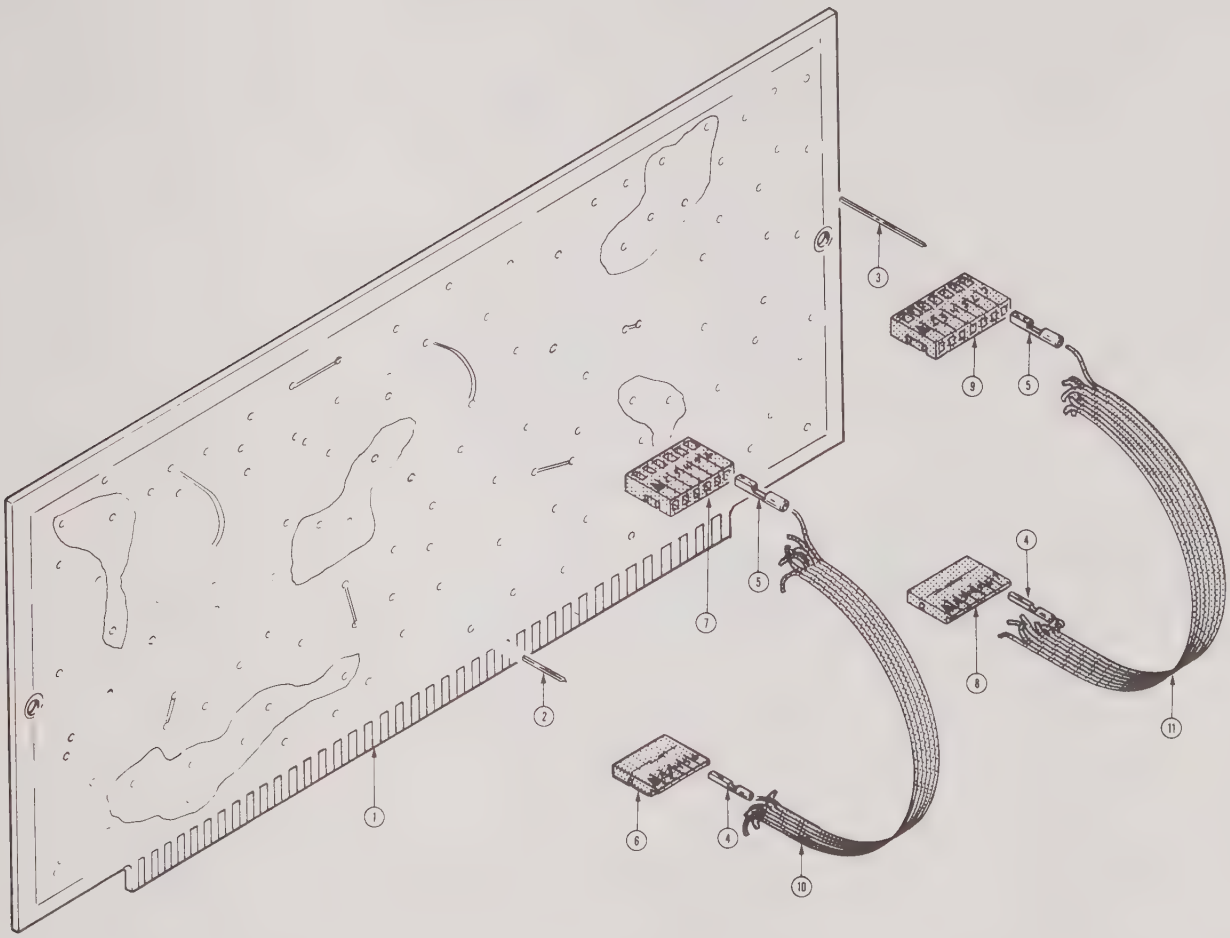
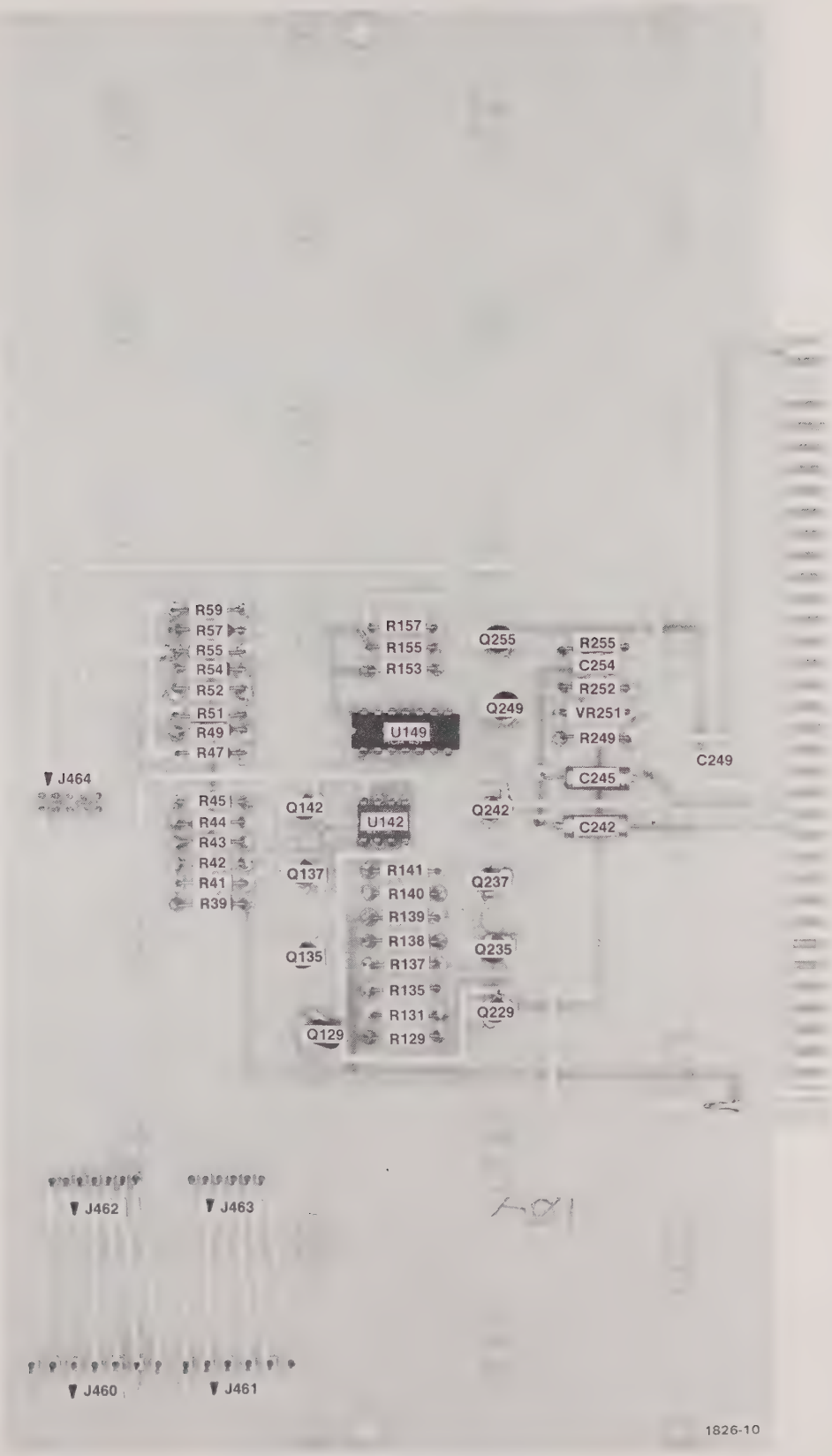


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	018-0103-00			1	CKT BD ASSY:JOYSTICK ADAPTER	80009	018-0103-00
-1	----- -----			1	. CKT BOARD ASSY:JOYSTICK ADAPTER(SEE EPL)		
-2	131-0608-00			10	. . CONTACT,ELEC:0.365 INCH LONG	22526	47357
-3	131-0787-00			26	. . CONTACT,ELEC:0.64 INCH LONG	80009	131-0787-00
	175-1660-00			1	. CA ASSY,SP,ELEC:	80009	175-1660-00
-4	131-0707-00			13	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-5	131-0621-00			13	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-6	352-0164-03			1	. . CONN BODY,PL,EL:6 WIRE ORANGE	80009	352-0164-03
-7	352-0202-01			1	. . CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0202-01
-8	352-0165-02			1	. . CONN BODY,PL,EL:7 WIRE RED	80009	352-0165-02
-9	352-0203-00			1	. . CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0203-00
-10	175-0829-00			FT	. . WIRE,ELECTRICAL:6 WIRE RIBBON	83501	TEK-175-0829-00
-11	175-0830-00			FT	. . WIRE,ELECTRICAL:7 WIRE RIBBON	08261	TEK-175-0830-00


R59
R57
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R54
R52
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R49
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U142
Q137
Q135
Q129
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R155
R153
U149
R141
R140
R139
R138
R137
R135
R131
R129
Q255
Q249
Q242
Q237
Q235
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VR251
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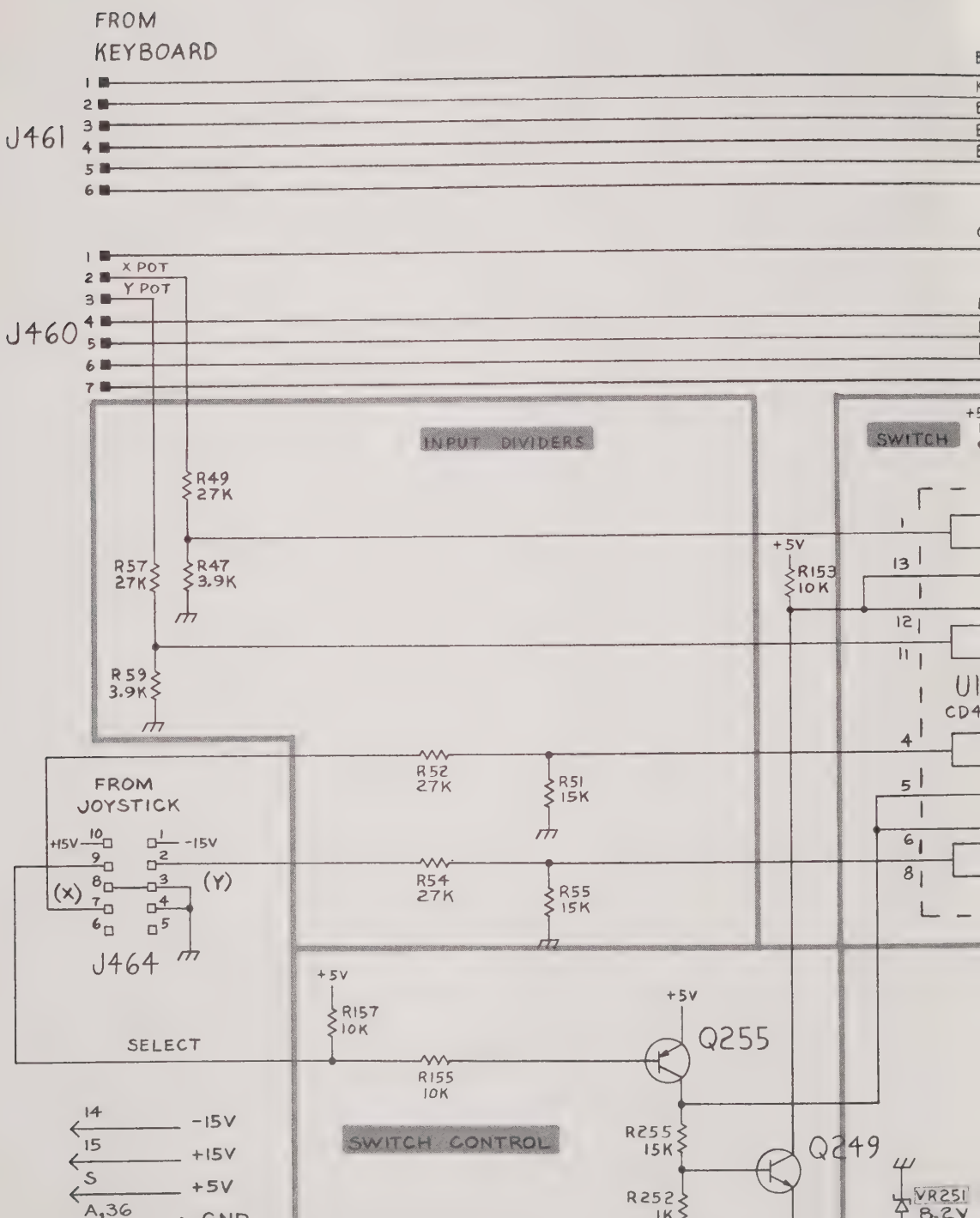
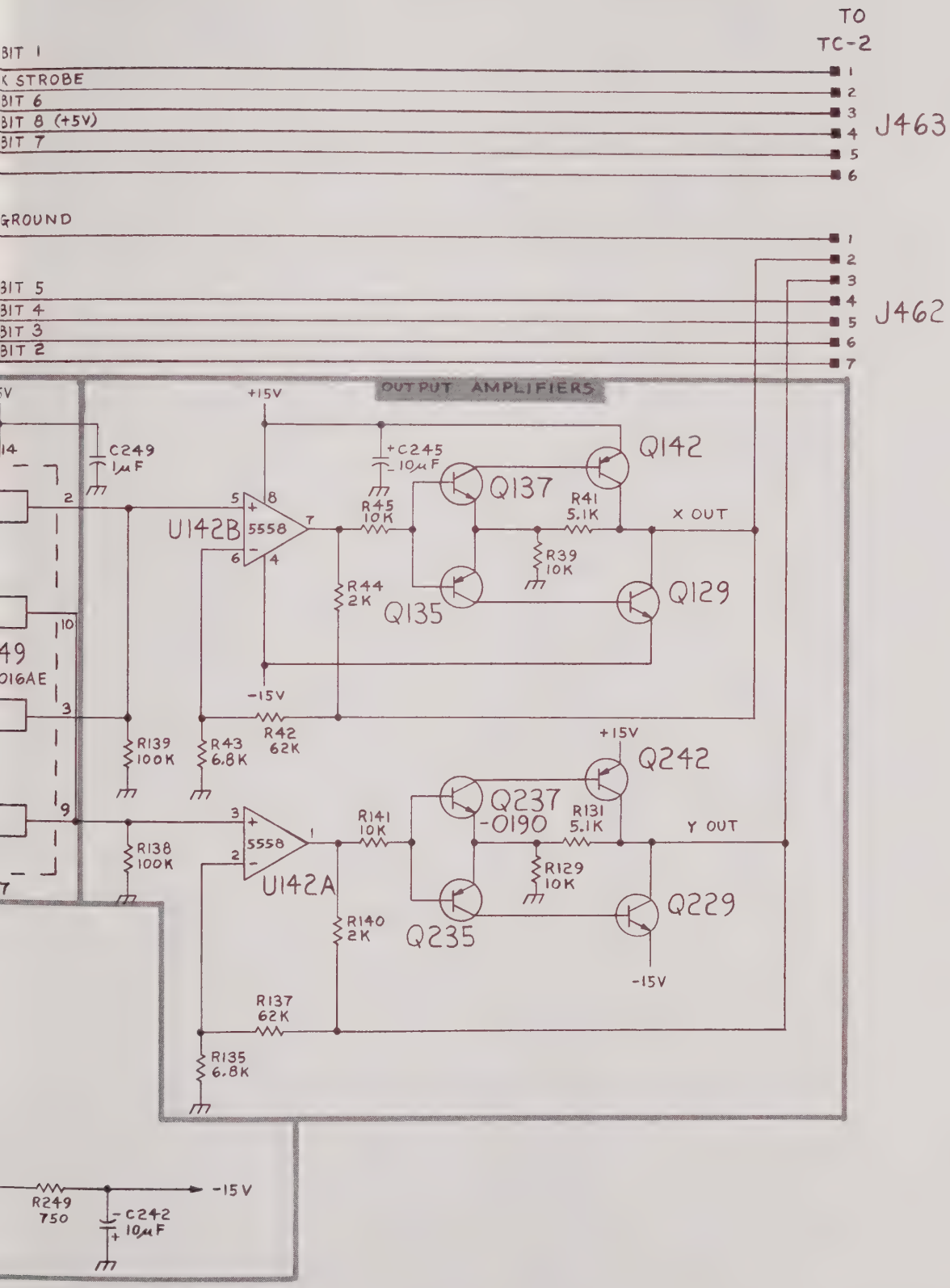
C245
C242
C249
J462
J463
J460
J461
1826-10



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



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JAN 1977

JOYSTICK ADAPTER

670-4041-00,01

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT 4952 JOYSTICK
070-1826-01

CHANGE REFERENCE M23,827
DATE 1-20-76

CHANGE:	DESCRIPTION

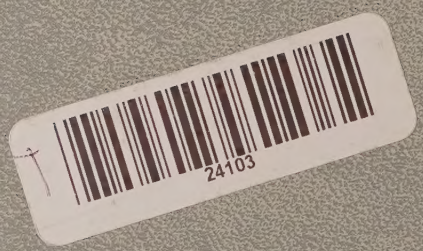
ELECTRICAL PARTS AND SCHEMATIC CHANGE

4952 (Option 1)

Page 5

CHANGE TO:

	670-4041-01	CKT BOARD ASSY:JOYSTICK ADAPTER
VR251	152-0217-00	SEMICOND DEVICE:ZENER:0.4W,8.2V,4.5%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